FEDERAL FINANCIAL REPORT (Follow form instructions) 1. Federal Agency and Organizational Element Federal Grant or Other Identifying Number Assigned by Federal Agency of Page to Which Report is Submitted (To report multiple grants, use FFR Attachment) 1 N62909-16-1-2057 Office of Naval Research Global 86 Blenheim Crescent, Ruislip MX HA4 7HB, United Kingdom pages 3. Recipient Organization (Name and complete address including Zip code) National Applied Research Laboratories (NARLabs) 3F, 106, Heping E, Rd., Sec. 2, TA AN DIST., 10622 Taipei City, REPUBLIC OF CHINA(TAIWAN) 7. Basis of Accounting Recipient Account Number or Identifying Number 6. Report Type (To report multiple grants, use FFR Attachment) ☐ Quarterly 44-444444 658460555 □ Semi-Annual ☐ Annual □ Cash 

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IEEE Instrumentation a	and M	easurement <sup>-</sup>	Technology Conference	ence	2016 (is	always ab	breviated as IEEE I2MTC 2016 or		
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attracts more than 235	atten	dees from 4	1 countries/areas. T	here	e were 1	plenary tal	k, 2 keynotes, 16 tutorials and 294		
papers presented during	ng the	Conference.	I2MTC 2016 includ	led r	new tech	nical activit	ties, the industry sessions, special talks		
							ed talk session. All the key events and		
the hot topics revealed	by th	is conference	would be reported	and	l highligh	ted in this	report.		
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# Office of Naval Research Global (ONRG) Final CSP (Collaborative Science Program) Report

# **Administrative Details:**

Event Name: IEEE Instrumentation and Measurement Technology Conference 2016 (IEEE I<sup>2</sup>MTC 2016)

Event Dates: May 23rd ~May 26th, 2016

Event City and Country: Taipei, Taiwan

Grantee (Name and Contact Information):
NATIONAL APPLIED RESEARCH LABORATORIES
3F, NO. 106, SEC. 2, HEPING E. RD., TAIPEI City 10622, Taiwan

Principal Investigator (Name and Contact Information):

Chi Hung Hwang

E-mail: <a href="mailto:chhwang@narlabs.org.tw">chhwang@narlabs.org.tw</a>
Phone no. +886-35779911 ext. 557

ONRG CSP Grant Number: **N62909-16-1-2507** 

Date of the Final Report: Aug. 15, 2016

# Abstract:

IEEE Instrumentation and Measurement Technology Conference 2016 (is always abbreviated as IEEE I<sup>2</sup>MTC 2016 or I<sup>2</sup>MTC 2016) is the flagship conference of IEEE Instrumentation and Measurement Society. The I<sup>2</sup>MTC is held annually, and the first Conference was held in 1984 in Long Beach, California. The I<sup>2</sup>MTC 2016 in Taipei is the 31<sup>st</sup> annual meeting in its history. I<sup>2</sup>MTC is an international technical forum focused on science and application of instrumentation and measurement. The Conference consists of tutorials, technical conference sessions (both oral and poster sessions), exhibits, keynotes and plenary talk integrated with social activities. In 2016, the Conference attracts more than 235 attendees from 41 countries/areas. There were 1 plenary talk, 2 keynotes, 16 tutorials and 294 papers presented during the Conference. Other than traditional events, I<sup>2</sup>MTC 2016, included new technical activities, the industry sessions, special talks which highlighted the issues of paper preparation for submission, and a special invited talk session which responded the question on the "Opportunities, Challenges, and the Future in Instrumentation and Measurement". All the key events and the hot topics revealed by this conference would be reported and highlighted in this report.

# **Event Summary:**

# 1. Focusing Theme of the Conference

The theme of IEEE I2MTC 2016 was decided to be "Measuring the pulse of Industries, Nature and Humans", and the purpose of the theme was to highlight the challenges of sustainable development of the region and even the worldwide. Within IEEE Region 10 (including Asia and Oceania), which is of denser populations, strong SEMI industries, and complex natural disaster, the economy grew rapidly in the past two decades thanks to strong manufacturing benefited by an extreme large working population, cheap electrical power, low cost water supply, and even natural resources. The strong economy growth changes daily life of people, as industrial waste and land development introduce a high pressure to the environment. Meanwhile, the natural disaster complexities are high in this region. Typical natural disaster such as earthquakes, volcanic eruptions, and typhoons are always followed by tsunamis, landslides and floods over wide-territory. There are new challenges introduced by human activities, smog, PM 2.5, in addition to the natural (mining rare-earth miner) and manmade toxicants spreading. In 2010, the Society called for proposals for a potential solution on controlling the oil spill from explosion spreads in Gulf of Mexico which revealed the important direction we could pursue. Back to the conference theme, the "pulse" means the signal (message) from industries, nature and humans after excited by the economic activities of humans; "measuring" is to detect and to understand the messages; the purpose of the theme is to highlight the importance of Instrumentation and Measurement Technology to the lives and livelihood of people, especially the abuse natural resources for economic development and the impact on humans.

# 2. Technical Program

The organization committee of I<sup>2</sup>MTC 2016 Conference organized 26 tracks, including 13 special issues. The regular Trackers of the conference are,

- Advances in Instrumentation and Measurement Developments and Techniques
- Data Acquisition Systems and Real-Time Measurements
- Energy and Power Systems
- Image Processing and Computational Intelligence Techniques
- Measurement and Instrumentation for Industrial Applications and Processes
- Measurement Applications and Software
- Measurement of Electric and Magnetic Quantities
- Measurement Systems and Theory
- Measurement, Instrumentation, and Methodologies for Medical, Biomedical, and Healthcare Systems
- Non-invasive Measurement Techniques and Instrumentation
- Robotics, Control, Mechanical, and Material Measurements
- Sensors, Actuators, Transducers, and Sensor Fusion
- Signal Processing Techniques

The other 13 Special Sessions have been proposed, whose topics are

- Six-Port and Multi-Port Technology for RF Sensing Applications
- Impedance Spectroscopy for Measurement and Sensor Solutions
- Advances in Industrial Tomography: Sensor design, Instrumentation, Image Reconstruction algorithms and Measurement
- Advanced Measurement and Data Processing for Complex Engineering System Health Monitoring
- Navigation technologies and related applications
- Advanced Measurement and Instrumentation for NDT&E
- Instrumentation and measurement for improving quality, reliability and safety: new perspectives for research and industry
- Sensors and Instrumentation for Structural Health Monitoring

- Nanotechnology applications in Instrumentation and Measurement
- Smart Medical Devices for Diagnosis
- Networking Measurement
- Wearable and Implantable Wireless Sensors for Healthcare
- Measurements for emerging power systems

To complete the paper review procedures, the Conference organizer invited 3 professors (all of them are associated editors of IEEE Transections on Instrumentation and Measurement) as Technical Program Committee Co-Chairs. In addition to TPC co-chairs, there were 20 Associate Technical Program Committee Co-chairs and 250 reviewers to ensure the submitted papers have been reviewed by at least 2 reviewers to ensure the paper qualities.

The final decision of the submission papers was made after two phases peer review procedures; thanks to great reviewing works done by all TPC members, 294 out of 560 submitted papers have finally been accepted for publication during the Conference. To accommodate all accepted papers, 28 oral sessions and 2 plenary poster sessions were arranged.

The conference technical program has been arranged as the table hereinafter, for details please refer to the website (http://2016.imtc.ieee-ims.org/ - This website will be accessible for years)

# 3. Statistic of Accepted Papers

There were 560 papers submitted to the paper submission system. Before distributing all the submitted papers to reviewers, the papers which did not meet the basic requirements were first rejected. Therefore, only 80% papers have been distributed to TPC members for first review. After first review, 93 papers were decided to be accepted(the acceptance ratio was 21.6%, rejection ratio was 22.8% and 55.6% of the papers have to be revised). For the second review, the authors had to resubmit revised papers and a letter indicating the changes of resubmitted papers and the answers to all questions of reviewers. The reviewing procedures have made many authors decide to withdraw papers. The final acceptance ratio of regular papers was about 65%. The statistic of the submissions was presented as the following tables.

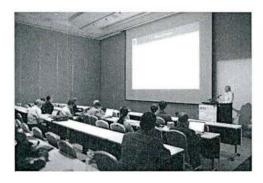
	Submission	То	1 <sup>st</sup> Review			2 <sup>nd</sup> Review			Acc.
		review	Accepted	Rejected	Revised	Withdrawn Acc	Accepted	Rejected	Rate
Regular Paper	551	353	89	84	180	32	132	16	62.61%
Special Sessions	86	77	4	14	59	14	54	0	75.32%
Total Paper	537	430	93	98	239	46	186	16	64.88%
Industry Papers	23	23	Not Ap	ply to	23	6	15	2	65.22%
Total	560	453	93	98	262	52	201	18	64.90%
Total Rejected		116							
Total Accepted		294							

The top 10 most paper submission countries/areas are tabulated hereinafter with acceptance ratio. Considering the Conference is in Asia, therefore China, Taiwan, Malaysia, and India were on the list. As for the acceptance ration, Austria, Italy, UK, China and Germany are the top five.

Country	No. of Accepted	No. of rejected	Acceptance Ratio
P.R. China	104	32	76.5%
Italy	43	2	95.6%
Taiwan	34	15	69.4%
Brazil	14	7	66.7%
USA	15	6	71.4%
Malaysia	12	10	54.5%
Germany	9	3	75.0%
United Kingdom	10	2	83.3%
Canada	8	2	80.0%
Austria	10	0	100.0%
India	10	6	62.5%
Total	269	85	76.0%

# 4. Oral Sessions, Poster Sessions and Exhibition

As indicated previously, there were 28 oral sessions and 2 plenary poster sessions arranged for the Conference. The oral sessions ran in parallel, 5 to 6 sessions were arranged at the same time. Within a single oral session, in general, 5 papers were presented. As for the poster sessions, both two sessions were arranged in the late morning and ran as a single session, while 74 papers were presented for a single poster session. To attract all participates to visit the poster sessions, the café breaks were arranged at the same time and same place of the oral sessions. Meanwhile, the exhibition area was also located at the same conference space to enhance the interactions between the attendees and the exhibitors.





The oral sessions were in parallel. Each session was chaired by two senior professors to ensure the oral presentations could run smoothly and the papers have been well discussed.









Poster sessions gathered conference attendees for discussion and exchanged achievements of researches and ideas.





Exhibition booths were set up at the same place of poster session. The arrangement made all attendees to be able to visit the booths after they met authors of the papers they were interested in.

# 5. Plenary Talk and Keynotes

The organization committees have invited 3 plenary speakers to share their experiences and viewpoints from academia research, industry and sensor application aspects. The talks have been arranged on the early morning from Tuesday to Thursday during the conference week. The topics and speakers were arranged as the following;

- Prof. Din Ping Tsai, Director and Distinguished Research Fellow of Research Center for Applied Sciences of Academia Sinica / "Plasmonic Metamaterials for Energy, Environment and Better Life" – Tuesday;
- Dr. JC Hsu, Vice President of MediaTek Ltd./ "IoT market and applications enabled by measurement and connectivity technologies" – Wednesday;

 Mr. Giuseppe Izzo, Regional Vice President of Greater China and South Asia Region, STMicroelectronics / "Smart Living in the Age of Digital Connectivity: Trends, Technology and Applications" – Thursday.



Prof. Din Ping Tsai presented "Plasmonic Metamaterials for Energy, Environment and Better Life" at plenary talk session.



Dr. JC Hsu presented "IoT market and applications enabled by measurement and connectivity technologies" on Wednesday morning keynote session.



Mr. Giuseppe Izzo shared his experience on "Smart Living in the Age of Digital Connectivity: Trends, Technology and Applications" on Thursday morning Keynote Session.

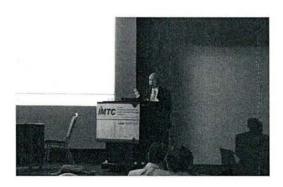
#### Invited Talks

I<sup>2</sup>MTC 2016 initiated an invited talk session entitled "Opportunities, Challenges, and the Future in Instrumentation and Measurement" to enhance the dialogue between academia and industries, also to find a direction for future development. We invited the immediate past President of IMEKO Prof. Pasquale Daponte (President of Italy Electronic Association), Chair of Asia Pacific Laboratory Accreditation Cooperation (APLAC) Nigel N. L. Jou, Director General of Center for Measurement Standards Dr. Tzeng-Yow LIN, the Director General of Instrument Technology Research Center Prof. J. Andrew Yeh, and Jun Watanabe from ALPS Japan to share their viewpoints from different aspects of measuring, accreditation, instrumentation traceability, 3D printing medical devices and instrumentation and measurement technologies for manufacturing industry. This event was chaired by Society Execute Vice-President Max J. Cortner who is from industry section. The presentations delivered by all speakers and the dialogue between invited speakers and conference attendees provided new prospects to all audiences. This invited talk session was held on May 25 Wednesday morning. The talks were as following;

- Prof. Pasquale Daponte, "Emerging technologies for measuring"
- Dr. Nigel N. L. Jou, "Application of Instrumentation and Measurement to Accreditation from Accreditor's Viewpoint"
- Dr. Tzeng-Yow LIN, "Measurement Traceability for New-Era Instrumentation: Taiwan Implementation"
- Prof. J. Andrew Yeh, "Roadmap of Medical Devices Industry in Taiwan -3D Printing Application"
- Mr. Jun Watanabe, "Creating IoT (Internet of Things) Solutions"



Invited Talk Session was chaired by IEEE IMS Executive Vice President Max Cortner.



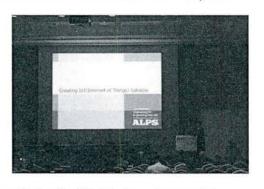
Prof. Pasquale Daponte presented "Emerging technologies for measuring."



Nigel N. L. Jou presented "Application of Instrumentation and Measurement to Accreditation - from Accreditor's Viewpoint."



Dr. Tzeng-Yow LIN presented "Measurement Traceability for New-Era Instrumentation: Tawan Implementation."



Jun Watanabe (ALPS, Japan) presented "Creating IoT (Internet of Things) Solutions."



Mr. You in place of Prof. J. Andrew Yeh presented" Roadmap of Medical Devices Industry in Taiwan -3D Printing Application."



There were dialogues between attendees and all the speakers after presenting (from left to right: VP Max Cortner, Nigel N. L. Jou, Dr. Tzeng-Yow LIN, Jun Watanabe, Prof. Pasquale Daponte, Mr. You).

# 7. Publications of Conference Paper

All the accepted papers including industrial papers were distributed to all conference registered attendees through cloud server. After the conference, all the accepted and presented conference papers (excluding the 17 industrial papers) have been submitted for publication through IEEE Xplore. Now the I<sup>2</sup>MTC 2016 Conference Proceedings has been proved for publication which could be founded by accessing the link hereinafter.

http://ieeexplore.ieee.org/xpl/mostRecentIssue.jsp?punumber=7508333

The I<sup>2</sup>MTC 2016 Special Issue of IEEE Transactions on Instrumentation and Measurement (as TIM) will contain papers selected on the basis of the results of regular peer review of the manuscripts submitted for consideration by the participants of I<sup>2</sup>MTC 2016. For I<sup>2</sup>MTC 2016, the special issue manuscript was uploaded in the period of June 20 to July 3, 2016. And now, all submitted papers are subjected to peer review procedures.

#### 8. Hot Topics of the Conference

There were 560 papers submitted to the Conference, as listed in the table hereinafter. According to the paper submission numbers, nct including special session papers, the first five hot topics of Conference 2016 are

- Measurement and Instrumentation for Industrial Applications and Processes
- Image Processing and Computational Intelligence Techniques
- Advances in Instrumentation and Measurement Developments and Techniques
- Sensors, Actuators, Transducers, and Sensor Fusion
- Measurement, Instrumentation, and Methodologies for Medical, Biomedical, and Healthcare Systems

Considering the "Measurement and Instrumentation for Industrial Applications and Processes" is too general to specify the special instrumentation and measurement technologies which the colleagues of the I&M Society are really interested in, "Non-invasive Measurement Techniques and Instrumentation" should be considered as one of the hot topics. Meanwhile, out of the 13 special sessions, "tomography" and "Measurements for Emerging Power Systems" are the special two hot topics which attracted more than 30 paper submissions.

Tracks	Accepted	Rejected	Withdrawn*	Subtotal
Advances in Instrumentation and Measurement Developments and Techniques	21	4	24	49
Data Acquisition Systems and Real-Time Measurements	10	8	5	23
Energy and Power Systems	19	6	3	28
Image Processing and Computational Intelligence Techniques	28	9	13	50
Industry Papers	15	2	6	23
Measurement and Instrumentation for Industrial Applications and Processes	31	21	27	79
Measurement Applications and Software	9	8	1	18
Measurement of Electric and Magnetic Quantities	8	1	8	17
Measurement Systems and Theory	5	7	11	23
Measurement, Instrumentation, and Methodologies for Medical, Biomedical, and Healthcare Systems	21	10	13	44
Non-invasive Measurement Techniques and Instrumentation	24	8	5	37
Robotics, Control, Mechanical, and Material Measurements	5	4	0	9
Sensors, Actuators, Transducers, and Sensor Fusion	28	9	10	47
Signal Processing Techniques	12	6	9	27
Special Sessions (13 tracks)	58	14	14	86
Total Submission				560

<sup>\*</sup>All the conference papers were subjected two phase review procedures. Many papers have been withdrawn because the authors could not meet the revision required by the reviewers within a month after the first phase review

# 9. News With Respect to Previous Conference

Beyond the Conference tradition, the organization committees reviewed the experiences of previous events and tried to implant new ideas to the conference program and do tests; in general, I<sup>2</sup>MTC 2016 is a test vehicle, and the organizing committee members devoted a lot of time to adjusting the program and making it better. The new aspects of the conference are highlighted hereinafter.

First of all, the conference was rescheduled from the second week to the third week of May. It was because most of the universities in North America end the spring semester by the second week of May. By rescheduling the conference time, we expected most of the colleagues from North America could be relieved from the conflict of doing heavy work before the end of the semester and be able to travel to attend the conference. We expected that more attendees from that area could be attracted to the Conference. On the contrary, however, considering the new Conference schedule might overlap with the other events, such rearrangement cause a high risk and high uncertainty to the conference organization. According the statistic of attendees after the conference, it was apparently that the amount of Conference

attendees was indeed dropped in compared to the averages of the last few years. On the other hand, thanks to strong supports from Region 10, the registrations were slightly increased with respect to the previous conferences held in Region 10.

Second, the conference tracks have been reintegrated based on the statistics of previous papers; the tracks could well reflect the trends of research activities on technologies and applications of instrumentation and measurement. In addition, all of the submitted papers could be assigned to tracks and been reviewed properly.

Third, to the enhance industry engagement and increase exchange between industry members, as well as between industry and academic members, I<sup>2</sup>MTC 2016 conference introduced the industry sessions. The industry sessions were different from the Industrial Applications and Processes track in regular sessions. For industry sessions, the role of industrial colleagues was emphasized. We intended to provide industrial colleagues the opportunities to present new technologies, new applications, or even new challenges. Foreseeing the essential difference between academia and industry, the submitted industry papers were limited to be less than 3 pages instead of 5-6 pages full paper. An additional request was that the first or the corresponding authors of submitted industry papers must be from industry sector to ensure that the major contribution did come from industry colleagues. Considering the paper lengths and review procedures for industry and regular sessions were not consistent, all accepted industrial papers would not be submitted for publication in IEEEXplore. Though high submission number was not expected, fortunately, the conference gathered enough qualified industry papers. The poster and oral sessions of industry papers were arranged on Thursday morning and afternoon respectively.

The last change was that the organizing committees have decided to provide conference proceedings from cloud server instead of distributing it via USBs or CDs. In the past decade, whenever we attended a conference, in most of the cases, we would receive an USB or a CD, in which the conference proceedings have been stored. In a realistic scenario, many USBs which we got from the conference might not be used again for years. Currently, cloud service is the most convenient way to store and to share documents, which dramatically changes the usage of store devices. To reflect the Conference theme we have highlighted this year, we would like I<sup>2</sup>MTC 2016 to be a "green" conference. Therefore, the Conference made a discussion and decided to distribute the conference proceedings through cloud service.

10. Attributes of Attendees Nationality

Nation/Area	No. of Attendees	Nation/Area	No. of Attendees	Nation/Area	No. of Attendees	
Australia	3	India	7	Saudi-Arabia	1	
Austria	9	Iran	2	Serbia	1	
Bangladesh	1	Italy	38	Singapore	1	
Belgium	2	Japan	7	Slovenia	1	
Brazil	4	Macao	1	Korea	4	
Canada	10	Macedonia	1	Spain	1	
China	118	Malaysia	7	Sweden	2	
Czech Republic	Committee 1		2	Switzerland	1	
Egypt	1	New Zealand	2	Taiwan	43	

Estonia	2	Nigeria	1	Tunisia	1
Finland	2	Pakistan	5	United Kingdom	5
France	3	Poland	1	United States	13
Germany	9	Portugal	6	Vietnam	r 1
Hungary	1	Romania	1	Uruguay	1

11. Attendees from US Government Associated
According to the list of attendees, 3 participates were from US government associated departments, including ONRG Singapore, Navy Academy and National Laboratory.

# **Fund Utilization:**

The fund was utilized for Conference Venue related expense which included conference rooms (R101 AB, R101CD, R105, 201 A, B, C, D, E, F, 202, and lobby for Conference Registration and Information), projectors and microphones, setups for poster sessions, booths and directional signs. The expense for conference venue related was tabulated hereinafter.

Items	Amount	Remakes		
Conference Venue Expense	2,098,850.00			
1. Conference Room	1,374,850.00	All purchases were obeyed		
2. Projector and Audio Facilities	224,000.00	Procurement Law and under the		
3. Poster & Booth Setup	500,000.00	supervision of MOST of Taiwan		
Revenue	2,098,850.00			
1. Fund from ONRG	322,300.00	exchange rate 1 USD =32.23 NTD		
2. Fund from MOST, Taiwan	1,000,000.00			
3. Fund from MICE Program, Taiwan	347,691.00			
4. Local Patrons+ IEEE IMS	428,859.00	Local patrons include the research institutes, industries and personals+ IEEE IMS		
Balance (Revenue-Conference Venue Expanse)	0.00			

# Notable Outcomes:

- There were more than 325 attendees from 41 countries/areas participated the Conference. This was
  the highest number of the participating attendees to the Conference held in Asia in the I<sup>2</sup>MTC history.
- 2. 294 papers (oral sessions in parallel, 2 plenary poster sessions), 16 tutorials, 1 plenary, 2 keynotes, 1 plenary tutorial and 5 invited talks have been organized during the four-day Conference. The conference also gathered 13 exhibitors, which was also the highest number of exhibitors ever.
- 3. The first five hot topics of Conference 2016 are
  - (1) Image Processing and Computational Intelligence Techniques;
  - (2) Advances in Instrumentation and Measurement Developments and Techniques;
  - (3) Sensors, Actuators, Transducers, and Sensor Fusion;
  - (4) Measurement, Instrumentation, and Methodologies for Medical, Biomedical, and Healthcare Systems
  - (5) Non-invasive Measurement Techniques and Instrumentation
- 4. All the regular conference papers submitted for publication to IEEExplore have been accepted and published, which indicated that all papers have been reviewed properly and all accepted conference papers have met the publication criteria of IEEE.

# Lessons Learned:

- 1. From statistic of paper submissions amount and the acceptance ratio, the results indicate that Italy, China, UK, Austria and Germany are highly interested in attending this annual conference meeting and the qualities of papers are relatively excellent.
- The Conference has been rescheduled to the third week of May in order to attract more attendees
  from North America; nevertheless, the number of attendees from North America, especially from US,
  is below the expect number. Foreseeing the people from North America are important members of
  Instrumentation and Measurement Society, more plans on attracting attendees from North America
  have been initiated.
- 3. One of the conference attendees passed away because of myocardial infarction after he has arrived Taiwan. The Conference has a contract for accident insurance for all attendees in case there is any accident occurred within the Conference venue. However, the insurance contract does not include the emergency health treatment. For this year, the organizing committee missed to arrange an emergency-aid team at the Conference and social activities venues. Because of this sad incident, an emergency-aid team and a proper insurance of emergency health treatment should be seriously considered for the future Conference organization.
- 4. Although the scopes of the Conference have been defined to be instrumentation and measurement associated, not a small number of papers have been rejected because of out of the scope. Instrumentation and measurement are typical multidisciplinary technologies; therefore, to synchronize the viewpoint between the authors and the reviewers could be important to avoid too many papers to be rejected not because of the paper quality but out of conference scope.
- 5. The conference usually attracts more than 300 people worldwide; however, the majority is from China, Italy, Taiwan and Malaysia. Travelling expense and accommodation cost of the conference venue are two major concerns which cause some regular attendees from Brazil and Italy to choose to be absent. However, most of the cost concerns are not based on the real ground. Therefore, it is greatly significant if the conference can provide more clear information about the travelling and accommodation cost as soon as possible.